The National Coordination Office for Computing, Information, and Communications
Who we are, recent activities, and planned efforts

SC97
November 19, 1997
San Jose, CA

Sally E. Howe, Ph.D.
Acting Director

Kay Howell
Incoming Director

Organization Chart

WHITE HOUSE

Executive Office of the President
Office of Science and Technology Policy

Presidential Advisory Committee on High Performance Computing and Communications, Information Technology, and the Next Generation Internet

National Science and Technology Council

Committee on Computing, Information, and Communications (CCIC)

NCO for Computing, Information, and Communications

Applications Council

Computing, Information, and Communications R&D Subcommittee

Technology Policy Subcommittee

High End Computing and Computation Working Group (HECC)

Large Scale Networking Working Group (LSN)

High Confidence Systems Working Group (HCS)

Human Centered Systems Working Group (HuCS)

Education, Training, and Human Resources Working Group (ETHR)

Next Generation Internet

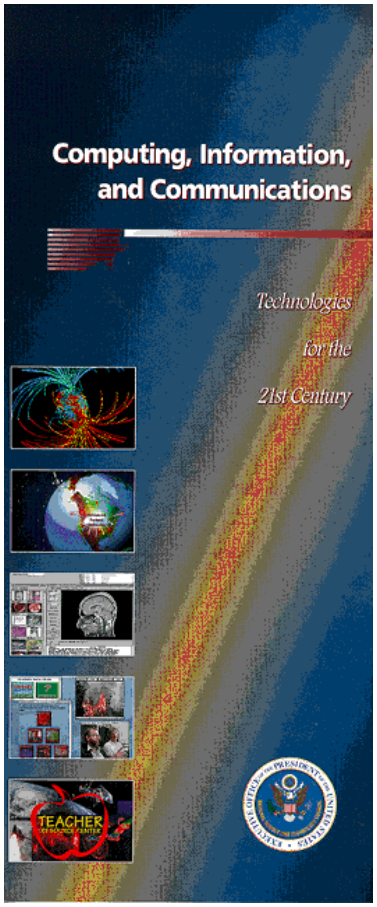
NCO Responsibilities (1)

- Work with OSTP and OMB to help the President set the Federal computing, information, and communications R&D agenda and budgets
- Justify the agenda and budgets to Congress
  - Testimony
  - Staff briefings

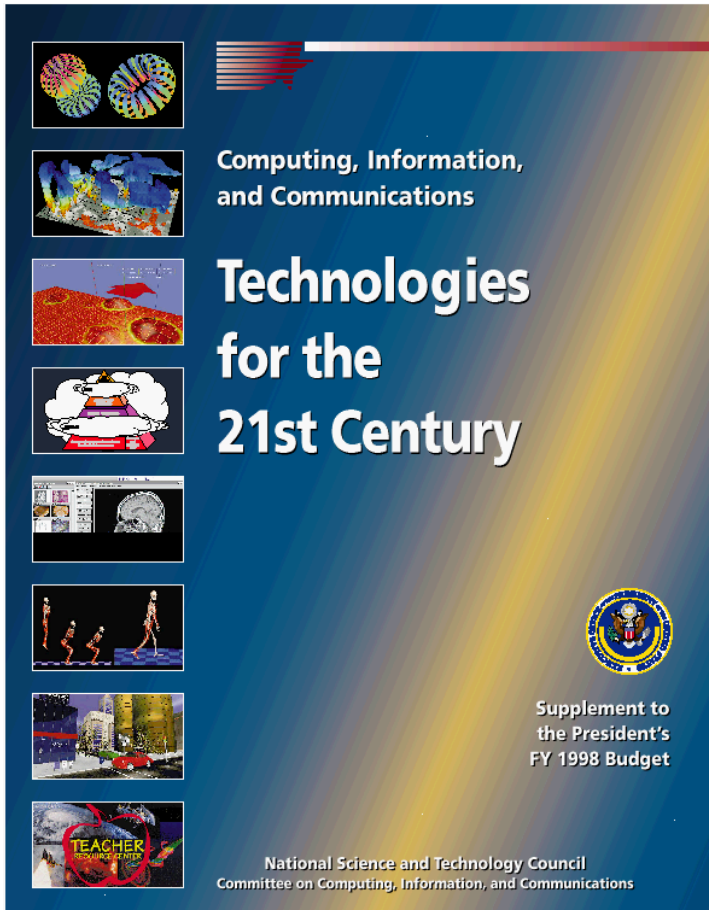
NCO Responsibilities (2)

- Document the coordinated Federal CIC R&D programs
  - Accomplishments
  - Plans
  - Budgets
  - Who does this work
- Outreach to other Federal agencies, state and local organizations, foreign organizations, academia, industry, and the public

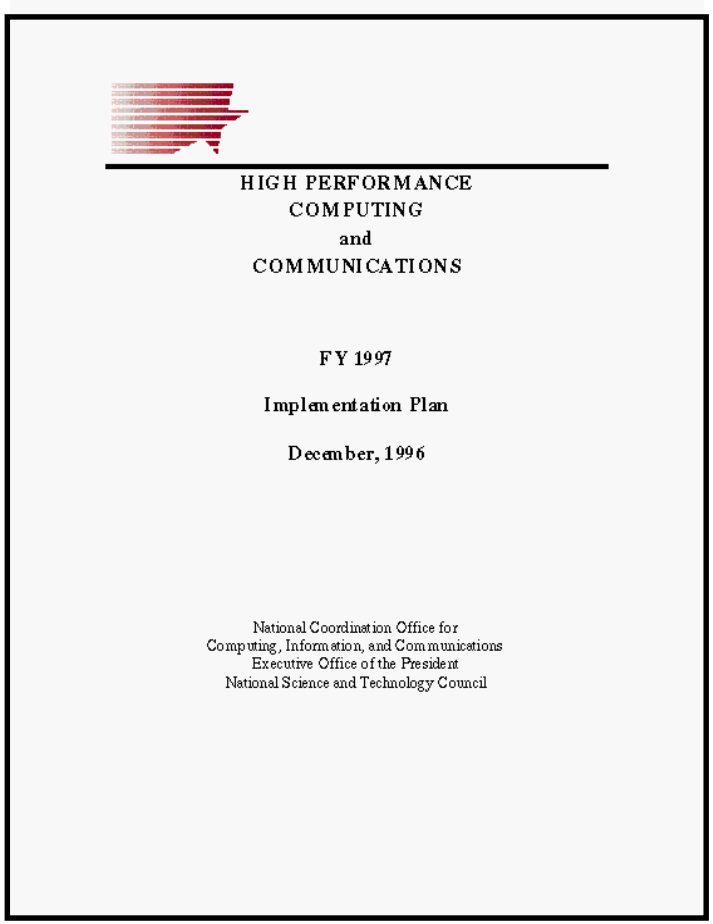
NCO Publications (1)



FY 1998 Brochure

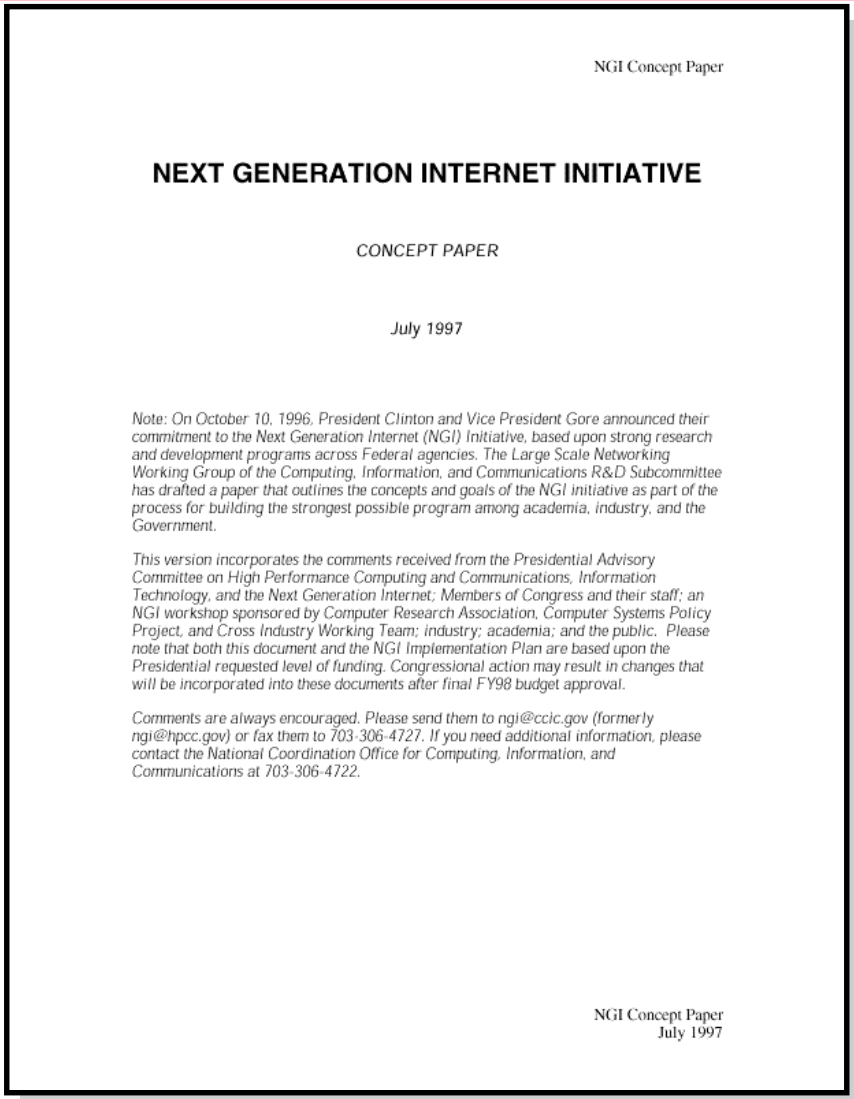


FY 1998 Blue Book



Annual Implementation Plan

NCO Publications (2)



NGI Concept Paper

NEXT GENERATION INTERNET INITIATIVE

CONCEPT PAPER

July 1997

Note: On October 10, 1996, President Clinton and Vice President Gore announced their commitment to the Next Generation Internet (NGI) Initiative, based upon strong research and development programs across Federal agencies. The Large Scale Networking Working Group of the Computing, Information, and Communications R&D Subcommittee has drafted a paper that outlines the concepts and goals of the NGI initiative as part of the process for building the strongest possible program among academia, industry, and the Government.

This version incorporates the comments received from the Presidential Advisory Committee on High Performance Computing and Communications, Information Technology, and the Next Generation Internet; Members of Congress and their staff; an NGI workshop sponsored by Computer Research Association, Computer Systems Policy Project, and Cross Industry Working Team; industry; academia; and the public. Please note that both this document and the NGI Implementation Plan are based upon the Presidential requested level of funding. Congressional action may result in changes that will be incorporated into these documents after final FY98 budget approval.

Comments are always encouraged. Please send them to ngi@ccic.gov (formerly ngi@hpcc.gov) or fax them to 703-306-4727. If you need additional information, please contact the National Coordination Office for Computing, Information, and Communications at 703-306-4722.

NGI Concept Paper
July 1997

FOR OFFICIAL USE ONLY

NGI

Next Generation Internet

Implementation Plan
Draft

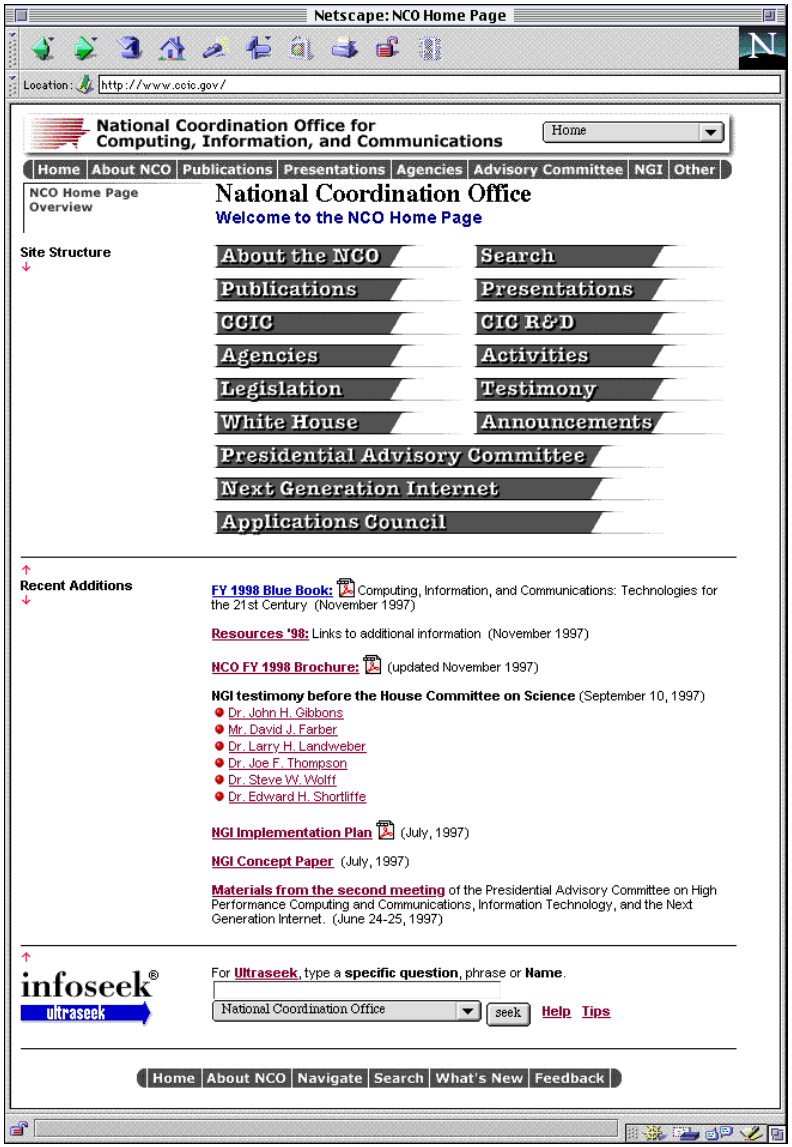
July 1997

Large Scale Networking
Next Generation Internet Implementation Team

Note: This plan incorporates the comments received from the Presidential Advisory Committee on High Performance Computing and Communications, Information Technology, and the Next Generation Internet; Members of Congress and their staff; an NGI workshop sponsored by Computer Research Association, Computer Systems Policy Project, and Cross Industry Working Team; industry; academia; and the public. Please note that both this document and the NGI Concept Paper are based upon the Presidential requested level of funding. Congressional action may result in changes that will be incorporated into these documents after final FY98 budget approval.

NGI Implementation Plan, Draft, July 31, 1997

NCO Web Site: *www.ccic.gov*



Presidential Advisory Committee (1)

- Advisory Committee on High Performance Computing and Communications, Information Technology, and the Next Generation Internet
- Established by Executive Order signed by President Clinton on February 11, 1997
- Advises the NSTC, through the Director of OSTP
- 25 non-federal members appointed by the President, including representatives of the research, education, and library communities, network providers, and representatives from critical industries

Presidential Advisory Committee (2)

- Assess
  - The HPCC (High Performance Computing and Communications) Program and its successor(s):
    - Progress
    - Need to revise
    - Balance
  - The Next Generation Internet initiative
  - Whether this R&D helps maintain U.S. leadership in advanced computing and communications technologies and their applications
- Meeting dates
  - February 27-28, 1997
  - June 24-25, 1997
  - December 9-10, 1997 (planned)
  - March 1998 (planned)

Presidential Advisory Committee (3)

Co-Chairs: Bill Joy, *Sun Microsystems*
Ken Kennedy, *Rice University*

Members

Eric A. Benhamou, *3Com Corporation*
Vinton Cerf, *MCI Communications*
Ching-chih Chen, *Simmons College*
David Cooper, *Lawrence Livermore National Laboratory*
Steven D. Dorfman, *Hughes Telecommunications and Space Company*
Robert Ewald, *Silicon Graphics, Inc.*
David Farber, *University of Pennsylvania*
Sherrilynne S. Fuller, *University of Washington*
Hector Garcia-Molina, *Stanford University*
Susan L. Graham, *University of California, Berkeley*
James N. Gray, *Microsoft Research*
W. Daniel Hillis, *Walt Disney Imagineering*
David C. Nagel, *AT&T Labs*
Raj Reddy, *Carnegie Mellon University*
Edward H. Shortliffe, *Stanford University School of Medicine*
Larry Smarr, *National Center for Supercomputing Applications*
Leslie Vadasz, *Intel Corporation*
Andrew Viterbi, *QUALCOMM Incorporated*
Steven J. Wallach, *CenterPoint Ventures*

Members announced on October 31, 1997

David W. Dorman, *PointCast, Inc.*
John P. Miller, *Montana State University*
Joe F. Thompson, *Mississippi State University*
Irving Wladawsky-Berger, *IBM Corporation*

CIC R&D Program Component Areas

- Five PCAs:
  - High End Computing and Computation (HECC)
  - Large Scale Networking (LSN)
  - High Confidence Systems (HCS)
  - Human Centered Systems (HuCS)
  - Education, Training, and Human Resources (ETHR)
- Each PCA:
  - Spans areas of multiple agencies involvement
  - Includes hardware, software, algorithms, and applications
  - Focuses on specific R&D goals, ensures adequate investments, and maintains necessary budget visibility
- Technology R&D may span PCAs
- Individual PCAs have own timelines
- Participation in PCA Working Groups is open to other agencies
- Applications span PCAs

High End Computing and Computation

- R&D to provide the foundation for U.S. leadership in computing through investments in:
  - Hardware and software innovations
  - Algorithms for modeling and simulation needed for computation- and information-intensive science and engineering applications
- Promote effective use of HECC for government, industry, academic, and broad societal applications
- Explore advanced concepts in quantum, biological, and optical computing

HECC Thrusts

1. System software technology
   Effective use of TeraFLOPS-scale systems
2. Future generations computing

   PetaFLOPS computing, distributed computing, and exabyte storage
3. Applications
   Use HECC technologies in agency applications
4. State-of-the-art infrastructure for HECC R&D
   Large-scale test systems, high performance computational grid and networks

HECC Strategy

- Community-developed HECC R&D agenda
- Increase funding levels for thrust 1 (system software) and thrust 2 (future generations computing)
- Sustain funding levels for thrust 3 (applications) and thrust 4 (infrastructure)
- Prefer jointly-funded/managed projects
- CCIC/CIC R&D/HECC Working Group coordinate agency programs
- Individual agencies lead specific efforts

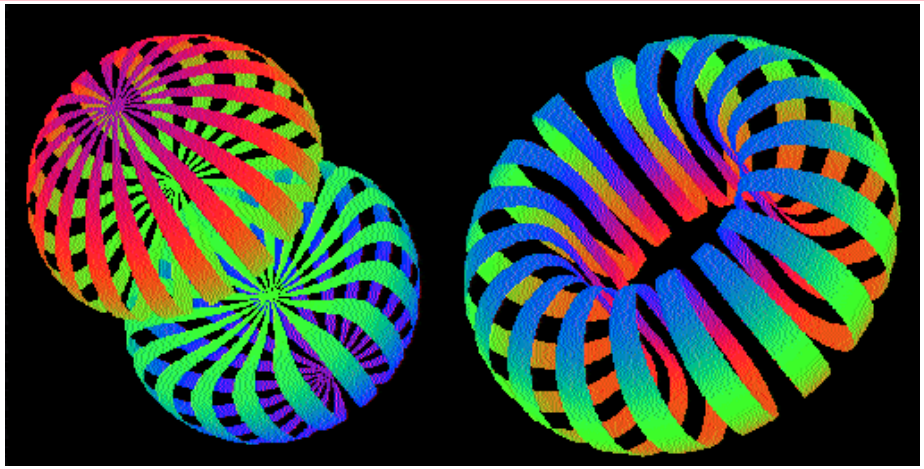
FY 1998 Blue Book: HECC Highlights (1)

- Advanced Computational Testing and Simulation (ACTS) Toolkit
- Partnerships for Advanced Computational Infrastructure (PACI)
  - National Partnership for Advanced Computational Infrastructure (NPACI)
  - National Computational Science Alliance (NCSA)
- ASCI's Academic Strategic Alliance Centers
- Scalable Systems and Software program

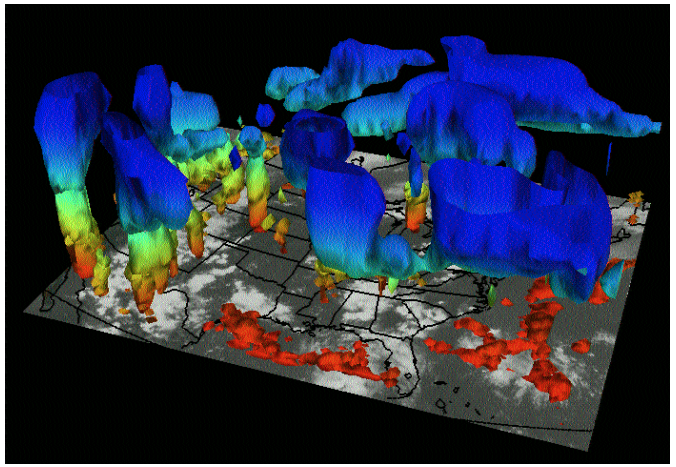
FY 1998 Blue Book: HECC Highlights (2)

- High Performance C++
- M-Machine
- National Compiler Infrastructure
- Parallelization of commercial engineering software
- Computational Aerosciences Project (CAS)
- Earth and Space Sciences (ESS)
- Biomedical research and biomolecular computing
- Supercomputing Research Program
- Quorum

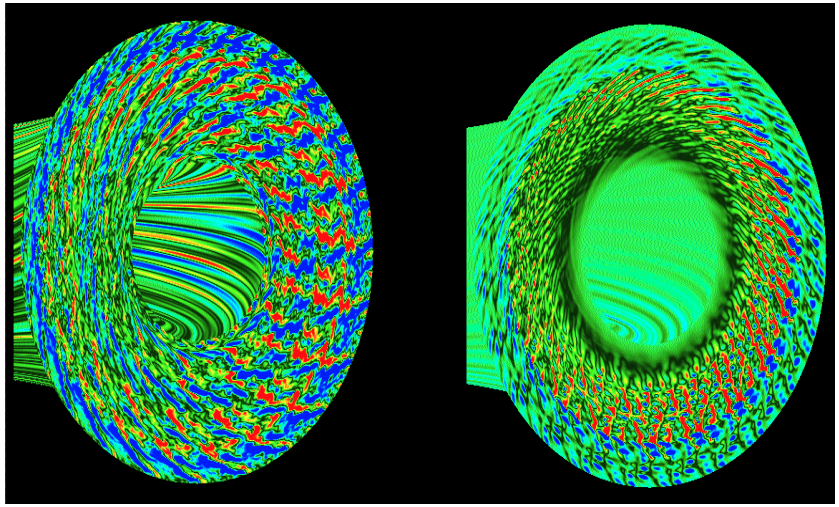
FY 1998 Blue Book: HECC Highlights (3)



Understanding the forces that hold nuclei together—a basic science Grand Challenge problem



Comparing remotely-sensed cloud data with 3-D cloud data predictions



Numerical Tokamak Turbulence Project—improving the design of fusion reactors

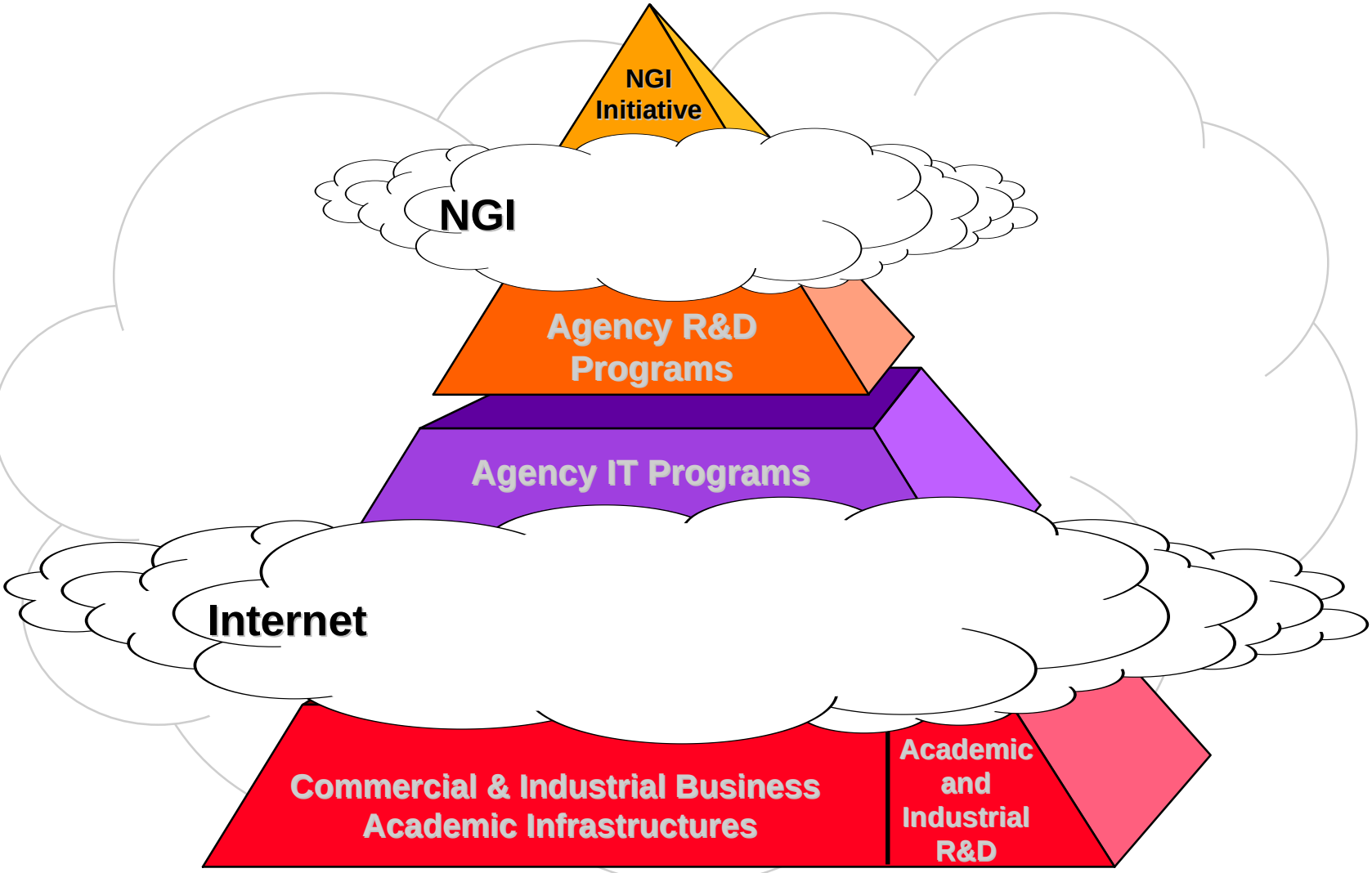
Large Scale Networking

- Goal is U.S. technological leadership
- Research in networking technologies, services, and performance:
  - Wireless, optical, mobile, wireline
  - Disseminating information to individuals, groups (multicast), or entire networks (broadcast)
  - Developing and executing scalable distributed applications
  - Engineering and managing large scale networks
- Testbeds and research infrastructure
- Includes Next Generation Internet (NGI) initiative

Next Generation Internet (NGI) Initiative

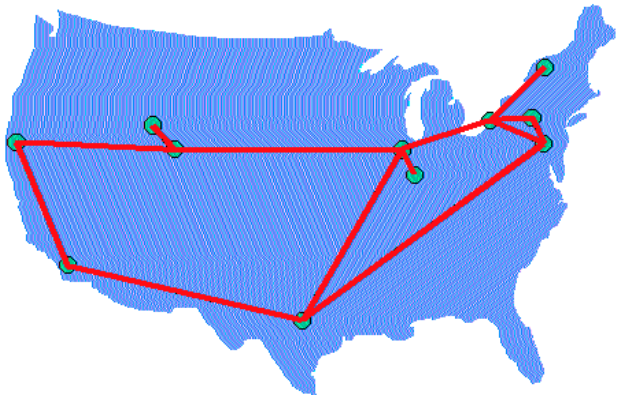
Goals	Metrics
1. Research in advanced network technologies	• Differentiation of service • Privacy and security • Adoption by private sector
2. Next Generation Internet network testbed — connect universities and Federal research institutions at rates sufficient to support research and demonstrate new technologies	• Ability to accommodate goal 1 research results and goal 3 applications • 100-to-1,000 times end-to-end performance improvement • Connects about 100 research institutions
3. Demonstrate new applications that meet important national goals	• 100+ high-importance applications • Value of applications in testing networking technologies

NGI Relationships

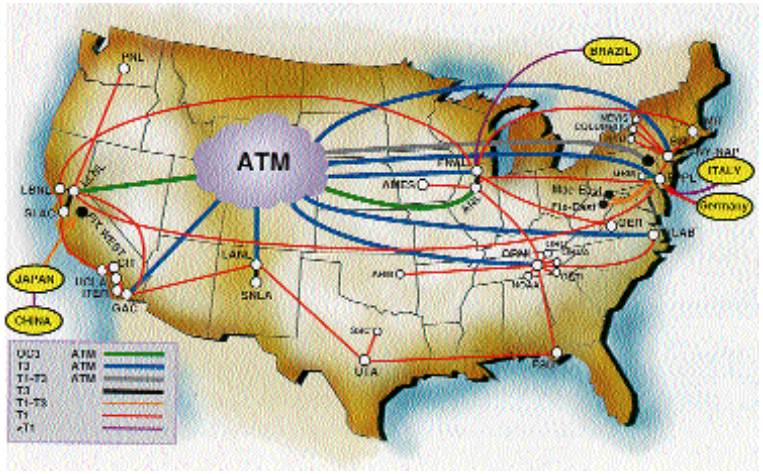


Federal Networks

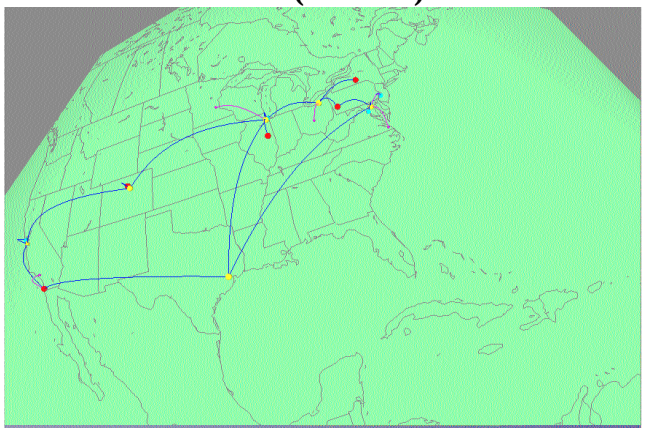
vBNS



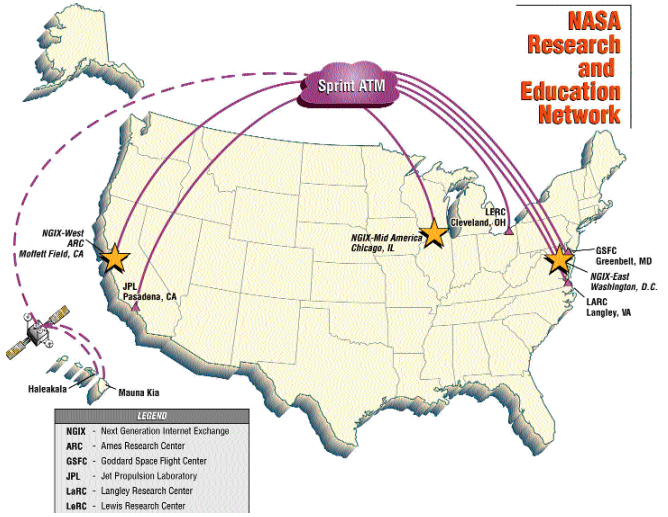
Energy Sciences Network (ESNet)



Internet Protocol Multicast Backbone (M-Bone)



NASA Research and Education Network (NREN)



NGI Goal 1 — Increased Capability

- Goal: effective, robust, and secure management, provisioning, and end-to-end delivery of differentiated service classes:
  - Network growth engineering
  - End-to-end quality of service (QoS)
  - Security
- Coordinated, multiagency development, deployment, and demonstration

NGI Goal 2 — Increased Capacity

- Guaranteed predictable end-to-end performance 100 to 1,000 times faster than today's Internet
- Manage large gigabit to terabit internetworks supporting a range of traffic classes on a shared infrastructure
- Testbed for lead users (government and research)
- Accelerate the development and deployment of new network applications

NGI Goal 3 — Revolutionary Applications

- Requirements:
  - Important to Federal agency missions
  - Needs high performance internetworking
  - Needs broadly applicable and scalable networking technologies
  - Has support from the application(s) community
- Prioritization based on:
  - Resource use
  - Timeliness
  - Ability to stress the NGI
  - Demonstrations / evaluations / validation / deployment / commercialization

Sources of Applications (1)

- Single agency missions
- Applications affinity groups
  - Basic science
  - Crisis management
  - Education
  - Environment
  - Federal information services
  - Health care
  - Manufacturing

Sources of Applications (2)

- Technology affinity groups
  - Collaborative technologies
  - Digital libraries
  - Distributed computing
  - Remote operations
  - Security and privacy
- Input from the CCIC Applications Council about other Federal applications
- Broad solicitations

NGI and Internet2:
Complementary and interdependent

NGI

- Federal program
- Will create an experimental, wide area, scalable testbed for developing mission-critical applications

Internet2

- Voluntary effort by more than 100 U.S. research universities
- Will meet end-to-end performance requirements by developing and deploying advanced network infrastructure – much provided by NGI

Both will develop and test advanced network technologies not supported by today's Internet, largely through NGI-funded research at Internet2 universities

FY 1998 Blue Book: LSN Highlights

- Global Grid
- Active Networks
- Unified Medical Language Systems (UMLS)
- National Center for Biotechnology Information (NCBI)
- Crisis management and disaster planning

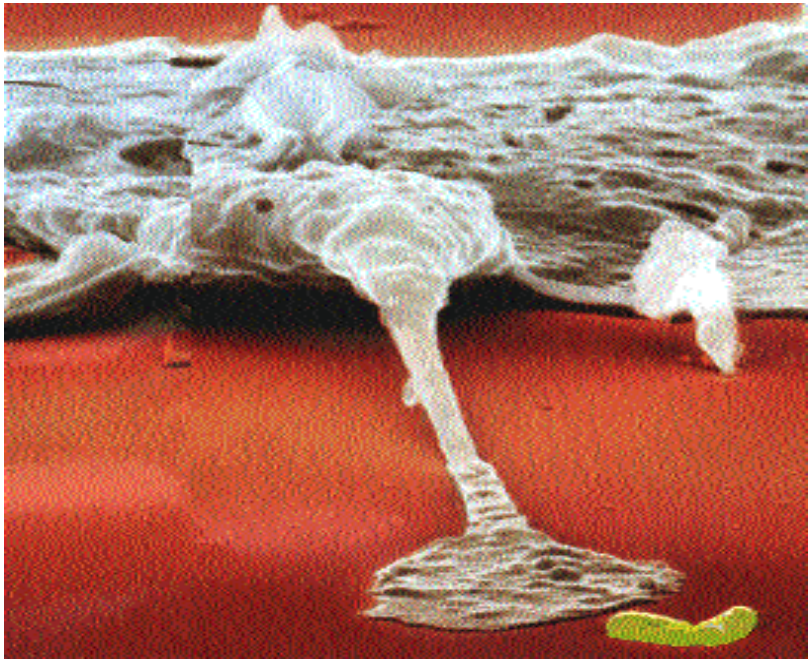
High Confidence Systems

- Technologies for achieving high levels of security, protection, availability, reliability, and restorability of information services
  - Systems will be resistant to component failure and malicious manipulation and will respond to damage or perceived threat by adaptation or reconfiguration
- Applications include:
  - National security
  - Law enforcement
  - Life- and safety-critical systems
  - Personal privacy
  - Protection of critical elements of the National Information Infrastructure

FY 1998 Blue Book: HCS Highlights (1)

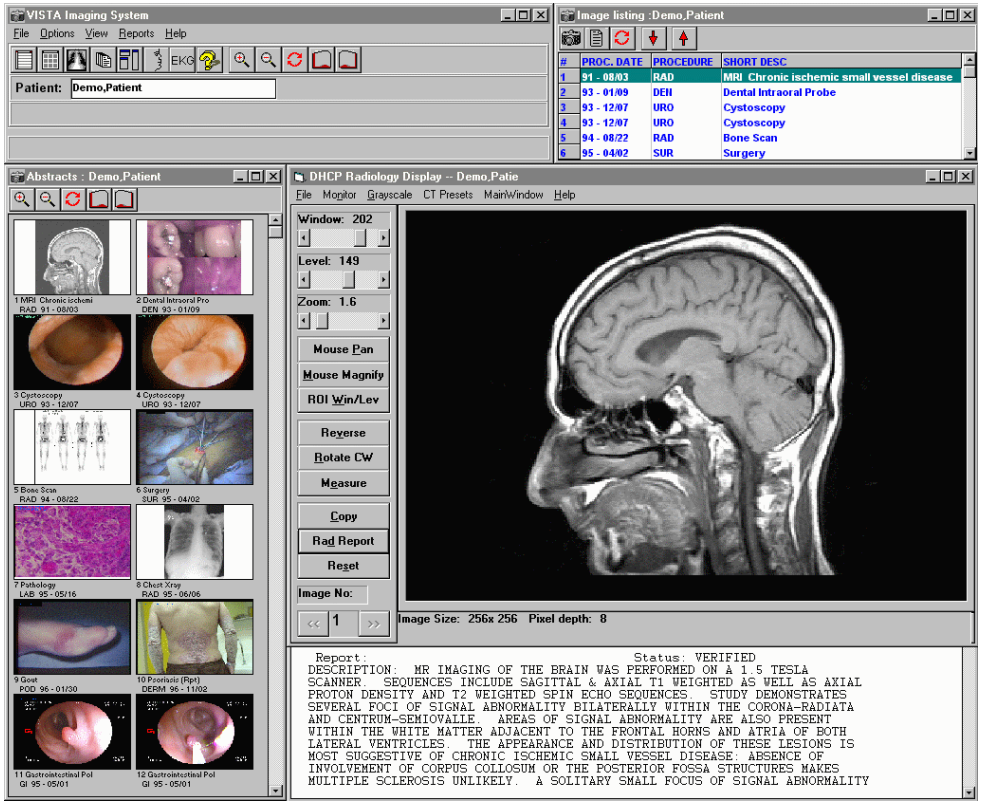
- Information Systems Security (INFOSEC)
- Secure operating system
- Graph-based Intrusion Detection System (GRiDS)
- Secure Access Wrapper (SAW)
- Task-Based Authorization (TBA)
- Secure All-Optical Networking
- Network infrastructure and security
- Protecting privacy for medical records

FY 1998 Blue Book: HCS Highlights (2)



Macrophage attacking a bacterium. Biological defense mechanisms detect external attack and respond to penetration. Using this metaphor, researchers have developed GrIDS (Graph-based Intrusion Detection System) to detect attacks using "specification-based intrusion detection."

Records containing multidisciplinary images will be available over networks to authorized health care providers through the merging of computerized patient record systems and telemedicine systems in a way that assures integrity and confidentiality.



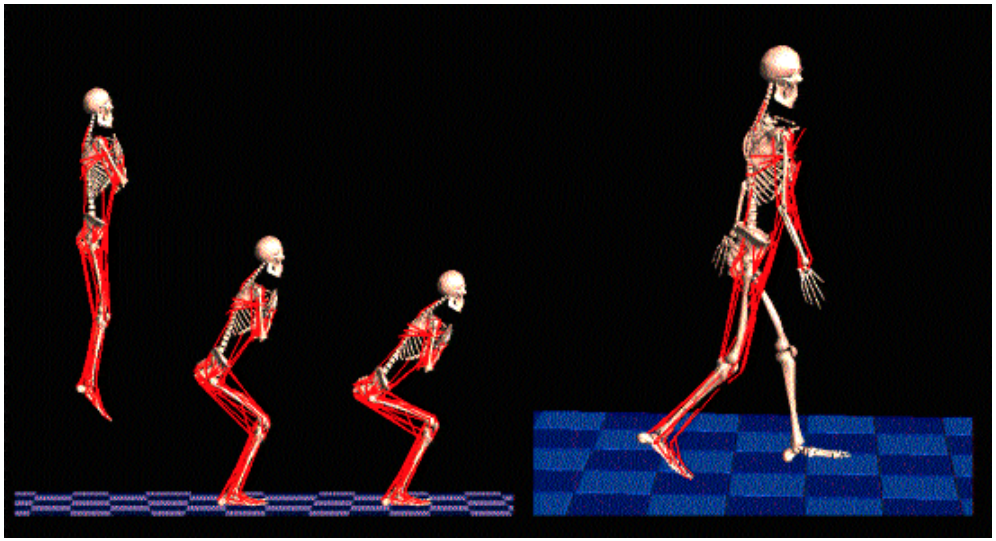
Human Centered Systems

- R&D to increase accessibility and usability of computing systems and communications networks
- Potential beneficiaries include scientists, engineers, educators, students, the workforce, and the general public
- HuCS technologies include:
  - Collaboratories
  - Knowledge repositories (including multimedia, machine learning, information agents)
  - Systems that enable multi-modal human systems interactions (including speech, touch, and gesture recognition)
  - Virtual reality environment
  - Intelligent sensors and I/O devices

FY 1998 Blue Book: HuCS Highlights (1)

- Knowledge repositories
- Collaboratories
- Regional Technology in Education Consortia
- Multi-modal human-system interactions
  - Speech, Text, Image, and MULtimedia Advanced Technology Effort (STIMULATE)
- Virtual environments
- Telemedicine
  - Visible Human Project
- Systems Integration for Manufacturing Applications (SIMA)

FY 1998 Blue Book: HuCS Highlights (2)



Scientists can estimate the forces of the body's muscles by simulating human movement on supercomputers. Researchers have combined control theory and mathematical modeling to determine musculoskeletal forces during different activities. These graphical models of jumping and walking incorporate joint angles from videotaped human subjects. Each muscle, with its connecting tendons, is represented by a three-element skeletal entity, appearing in series.

One view of a virtual city created using the Virtual Reality Modeling Language (VRML) by a team that is investigating the effects of visual cues in psychotherapy using the Internet and VRML. Potential applications include treating acrophobia (fear of heights) and other phobias. Patients might view this same street by looking down from the top floors of its skyscrapers.

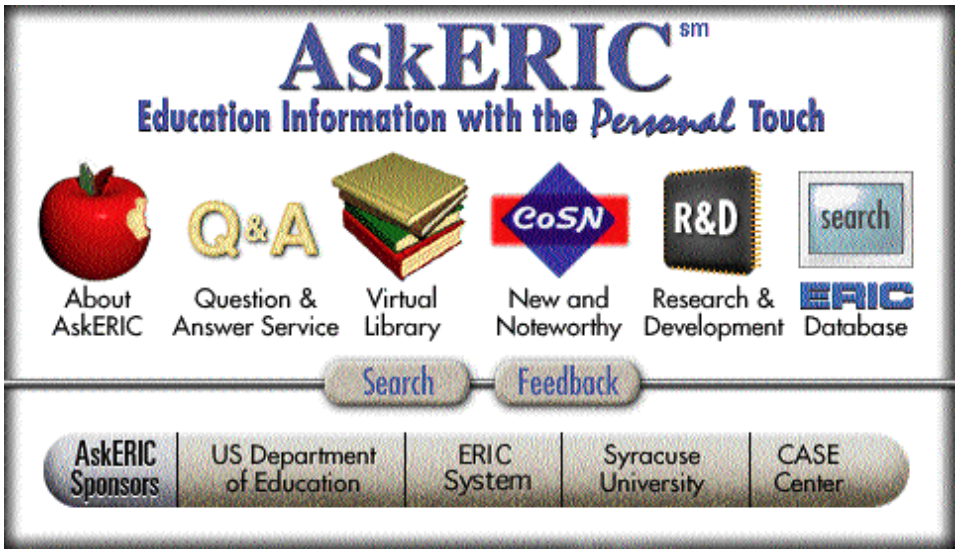
Education, Training, and Human Resources

- Research to advance education and training technologies
- Improve quality of science and education:
  - Educate and train students and professionals in applying the results of HECC and LSN R&D through —
    - Curriculum development, fellowships, and scholarships
- Lead to more knowledgeable and productive citizens:
  - Apply interdisciplinary research to learning technologies
  - R&D in information-based learning tools, lifelong learning, and distance learning

FY 1998 Blue Book: ETHR Highlights

Dramatic image of an erupting volcano on Russia's Kamchatka Peninsula — one of many images available through NSF's VizEarth Project.

AskERIC services provide users with customized information on educational topics delivered via the Internet and commercial services.



CIC R&D Research Facilities

NSF

Supercomputing Centers (through FY 1998)

- Cornell Theory Center (CTC)
- National Center for Supercomputing Applications (NCSA)
- Pittsburgh Supercomputing Center (PSC)
- San Diego Supercomputing Center (SDSC)
- National Center for Atmospheric Research (NCAR)

PACI Centers

- National Computational Science Alliance (NCSA)
- National Partnership for Advanced Computational Infrastructure (NPACI)

Science & Technology Centers

- Center for Cognitive Science
- Center for Computer Graphics and Scientific Visualization
- Center for Research in Parallel Computation (CRPC)

NASA

Testbeds

- Ames Research Center
- Goddard Space Flight Center
- Jet Propulsion Laboratory
- Langley Research Center
- Lewis Research Center

EPA

Systems

- National Environmental Supercomputing Center

DOE

Laboratories

- Argonne National Laboratory
- Los Alamos National Laboratory
- National Energy Research Supercomputer Center
- Oak Ridge National Laboratory

NIH

Systems

- Frederick Biomedical Supercomputing Center
- Supercomputing Resources

National Center for Research Resources' High Performance Computing Resource Centers

- Biomedical Computation Resource
- Parallel Computing Resource for Structural Biology
- Parallel Processing Resource for Biomedical Scientists
- Resource for Concurrent Biological Computing
- Supercomputing for Biomedical Research
- Theoretical Simulation of Biological Systems

National Center for Research Resources' Scientific Visualization Resource Centers

- Interactive Graphics for Molecular Studies
- Special Research Resource for Biomolecular Graphics

NOAA

Laboratories

- Forecast Systems Laboratory
- Geophysical Fluid Dynamics Laboratory
- National Centers for Environmental Prediction

FY 1998 CIC R&D Budget Request (Dollars in Millions)

Agency	HECC	LSN	HCS	HuCS	ETHR	Total
DARPA	84.8	89.2	9.4	137.9		321.3
NSF	132.9	79.2	0.9	60.2	21.0	294.2
DOE	90.8	48.8		9.9	3.0	152.5
NASA	90.1	25.0	2.8	2.2	8.3	128.4
NIH	23.7	28.2	4.1	29.3	6.4	91.7
NSA	26.4	2.2	7.2			35.8
NIST	4.0	5.5	3.4	13.6		26.5
VA		7.5	5.4	9.2		22.1
ED				12.0		12.0
NOAA	4.3	2.7		0.5		7.5
EPA	6.2					6.2
AHCPR				5.5		5.5
TOTAL	**463.2**	**288.3**	**33.2**	**280.3**	**38.7**	**1103.7**

NCO Recruiting

- Government detailees
- IPAs
- Short-term consultants

What next?

- FY 1999 Blue Book
- NGI
  - FY 1998 Implementation Plan
  - FY 1999 and FY 2000 Implementation Plans (and budgets)
- Presidential Advisory Committee
  - Review Federal CIC R&D agenda and budget
- Possible FY 2000 HECC initiative
- Possible FY 2000 educational technologies initiative